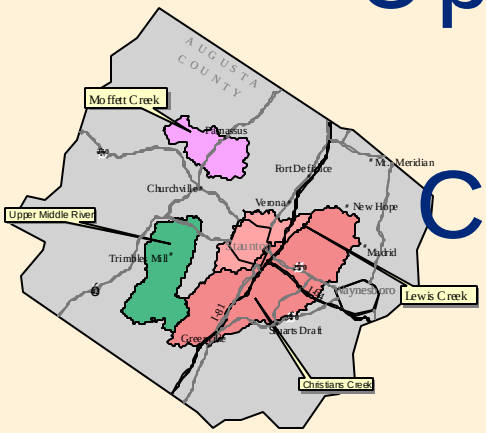
General Quality TMDLs

for

Upper Middle River
Moffett Creek
Christians Creek
Lewis Creek



12/3/2003

Total Maximum Daily Load

- Maximum amount of a pollutant that a water body can receive and still maintain water quality standards
- TMDL = WLA + LA + MOS

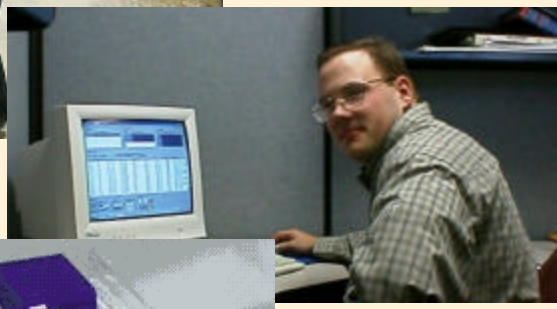
where WLA = waste load allocation

LA = NPS load allocation

MOS = margin of safety

TMDL Process

- Water Quality Assessment
  - Monitoring
  - Standards Evaluation
- TMDL Development
  - Determine Endpoints
  - Modeling
  - Load Allocation
- Implementation Plan Development
- Implementation



Project Background

- Impairment types in the Middle River watershed:
  - Fecal Bacteria
  - General Quality
    - AKA: Benthic or Aquatic Life
- MapTech contracted by Virginia's Department of Conservation and Recreation (DCR)
- Tonight's meeting:
  - General Quality TMDL

Applicable State Standard

General Standard

"All state waters shall be free from substances ... which are harmful to human, animal, plant, or aquatic life" (9 VAC 25-260-20)

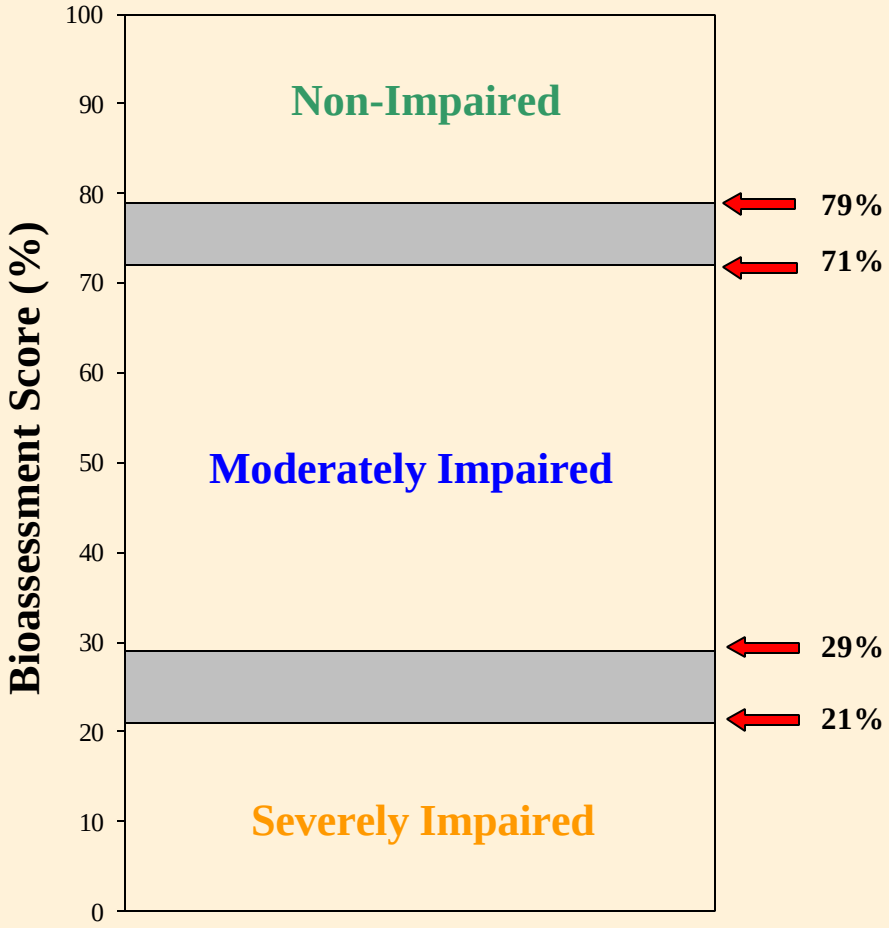
General Standard

- Aquatic Life impairments are detected through the assessment of a stream's Benthic Macro-invertebrate Community (Rapid Bioassessment Protocol, RBP).
- Comparison between Target Station and a Reference (i.e. non-impaired) Station.
- No assessment of *Stressors* (i.e. end points)

Water Quality Assessment

- All impairments listed based on assessments performed by DEQ from 1994 – 1996.
- Additional sampling performed 1996 – present confirms impairment.

RBP Assessment



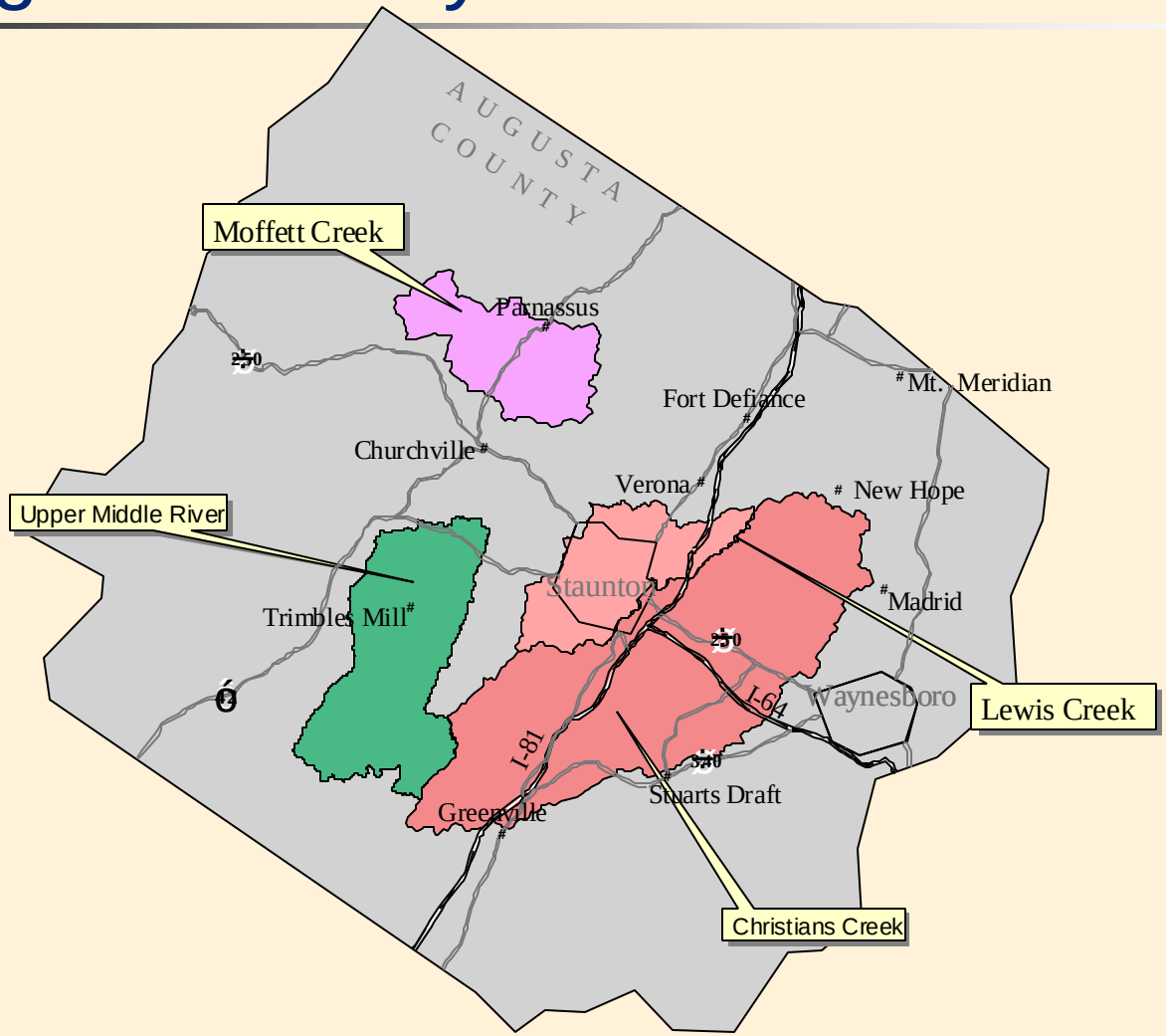
Optimum Community

Loss of Most Intolerant Orgamisms

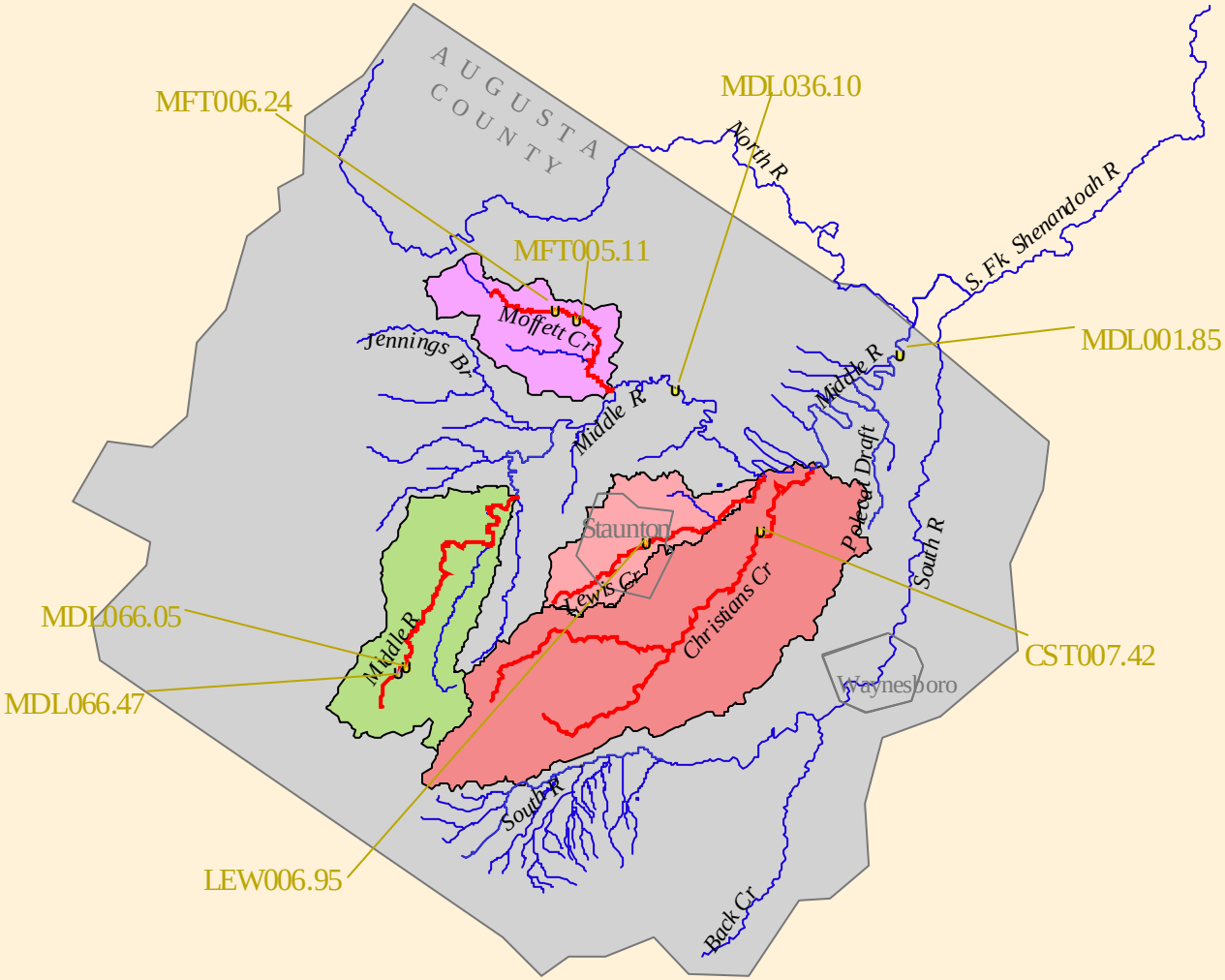
Few Species Present

Middle River Benthic Impairments

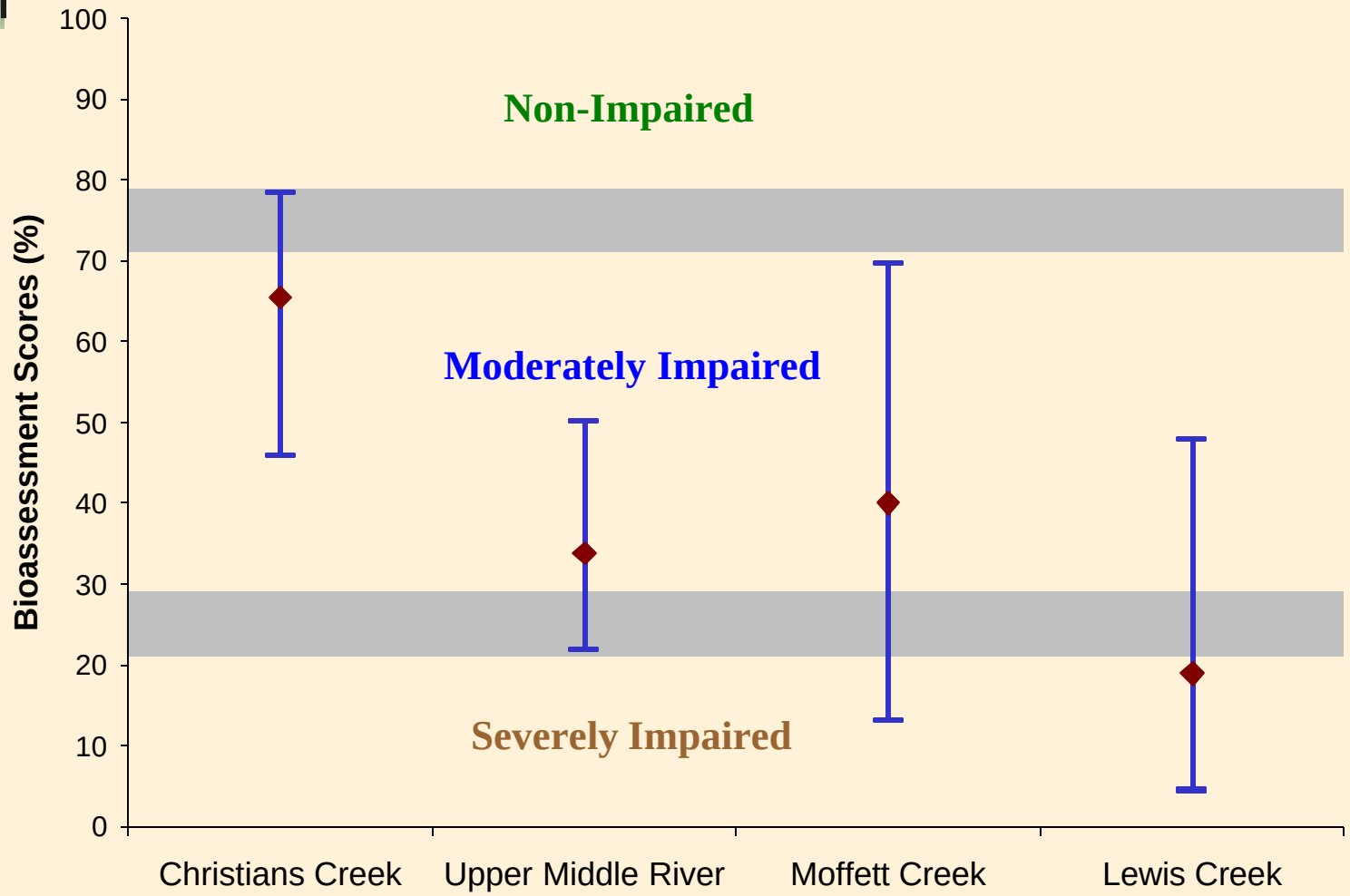
Augusta County



Aquatic Life Monitoring Network



BioAssessment Scores



Benthic TMDL Development

- Stressor analysis
- Endpoint determination
- Source assessment
- Model to determine TMDL allocations

Potential Stressors

- Limited primary energy source – tree leaves
- Sediment
- Toxics
- Low Dissolved Oxygen (DO)
- Nutrients
- pH
- Metals
- Dissolved Solids / Conductivity
- Temperature
- Organic matter

Stressor Analysis

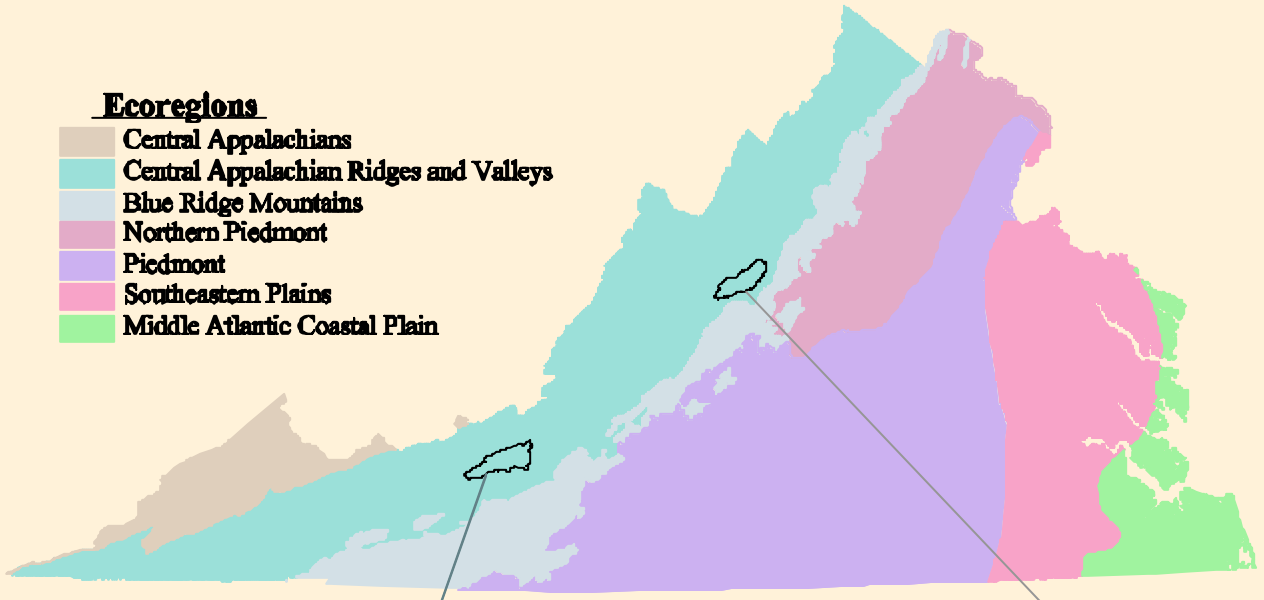
- Identify potential stressors
  - Stream surveys – habitat analysis
  - Comparison with reference watersheds
  - Toxicity studies
  - Pollutant level analysis
- Analyze data for each potential stressor
- Determine most probable stressor(s) for basis of TMDL

End Point Analysis

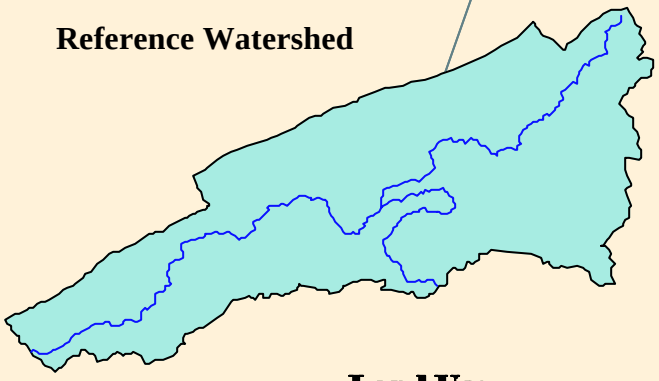
- Identify reference watershed(s).
- Determine water-quality end point based on values measured or modeled in reference watershed(s).

Reference Watershed Selection

- Identify candidate based on:
  - Stream order
  - Eco-region
  - Non-impairment status
- Compare various watershed characteristics
  - Level of identified stressor(s)
  - Data availability
- Select watershed in consultation with State biologist(s)

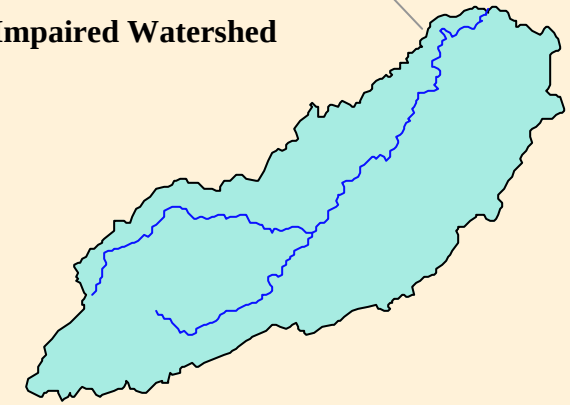


Reference Watershed



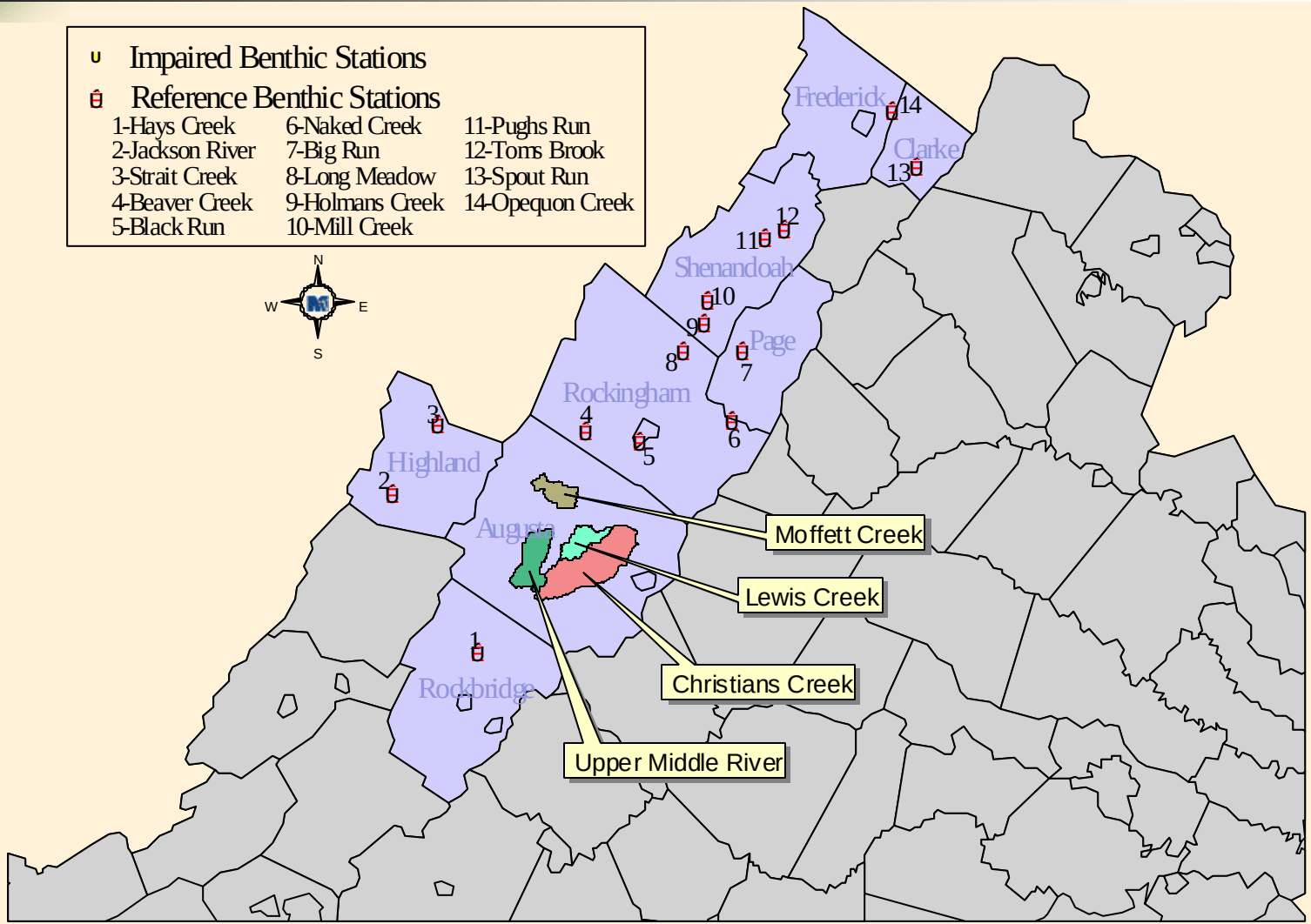
Land Use	
Forest	70%
Agriculture	23%
Urban	4%
Water	3%

Impaired Watershed



Land Use	
Forest	62%
Agriculture	28%
Urban	6%
Water	4%

Potential Reference Watersheds



Christians Creek
Reference Watershed Selection

Land Use	Christians	Opequon
Barren	1%	1%
Forest	26%	33%
Crops	8%	5%
Pasture	56%	51%
Residential/Urban	9%	10%
Total Acreage	68,844	62,192

Upper Middle River
Reference Watershed Selection

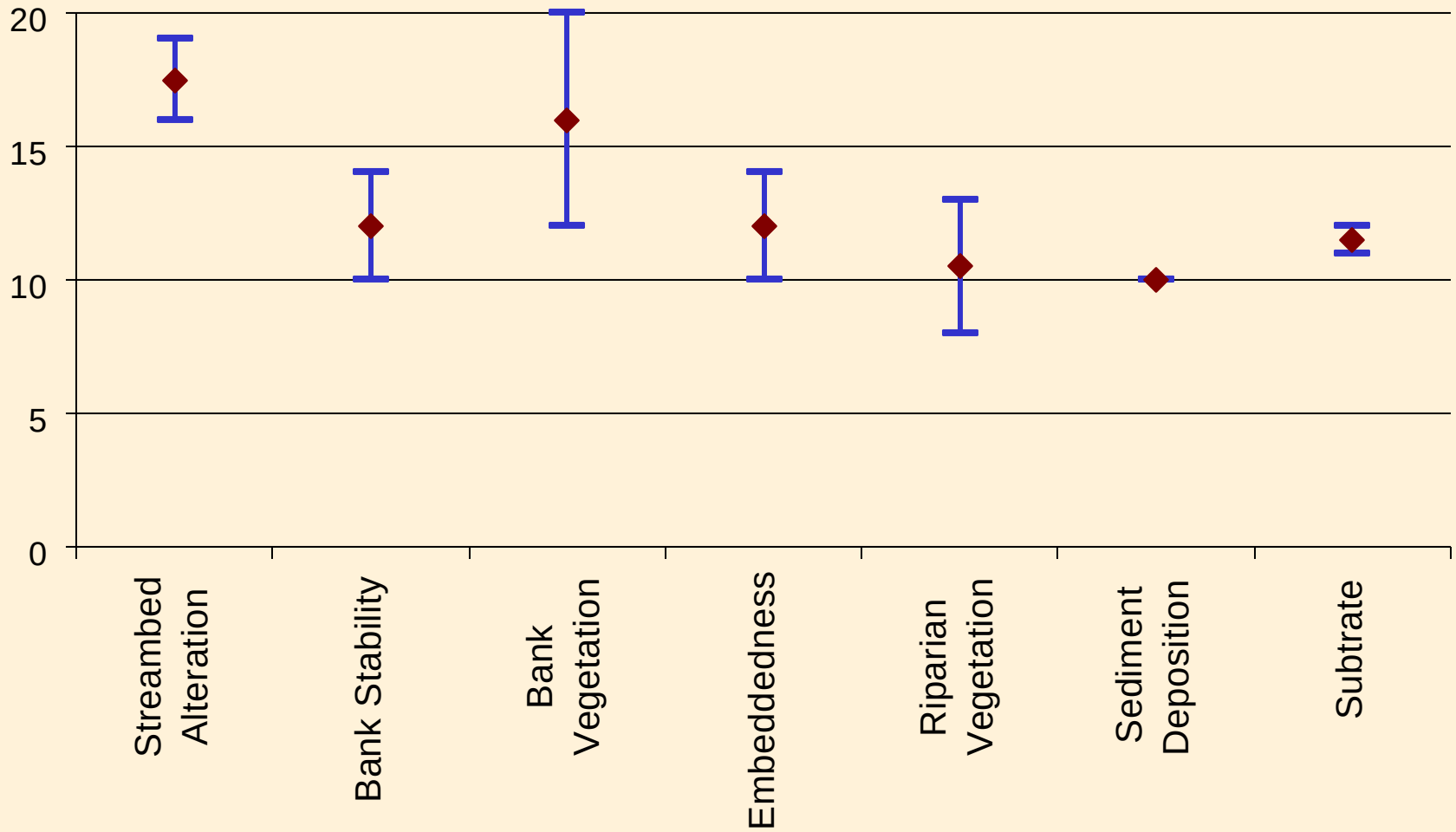
Land Use	Upper Middle	Hays
Barren	<1%	<1%
Forest	36%	52%
Crops	6%	2%
Pasture	56%	46%
Residential/Urban	<1%	<1%
Total Acreage	30,423	50,933

Moffett Creek
Reference Watershed Selection

Land Use	Moffett	Mill
Barren	0%	0%
Forest	50%	59%
Crops	5%	2%
Pasture	44%	38%
Residential/Urban	1%	1%
Total Acreage	16,996	25,452

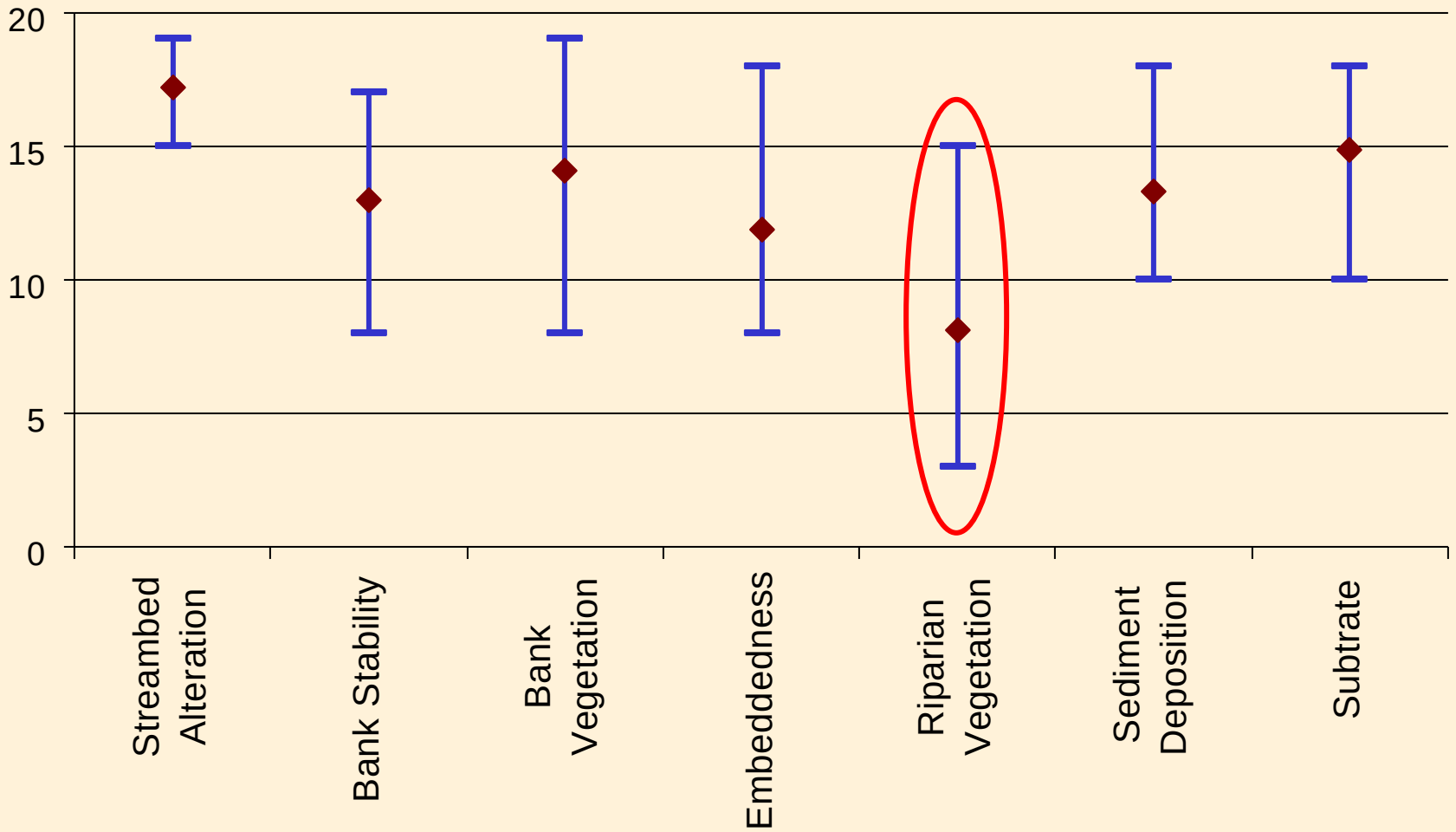
Habitat Analysis

Example Reference Watershed



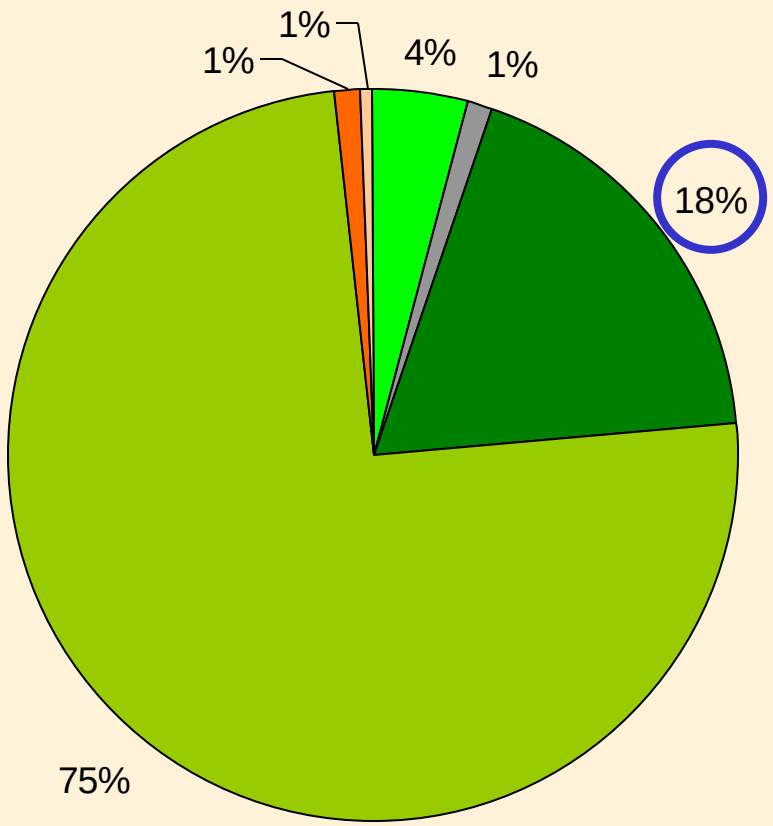
Christians Creek

Habitat Analysis



Christians Creek
Land Use in 1st Order Stream Corridor

Reference Watersheds
38 – 87% Forest



Christians Creek
Toxicity Analysis

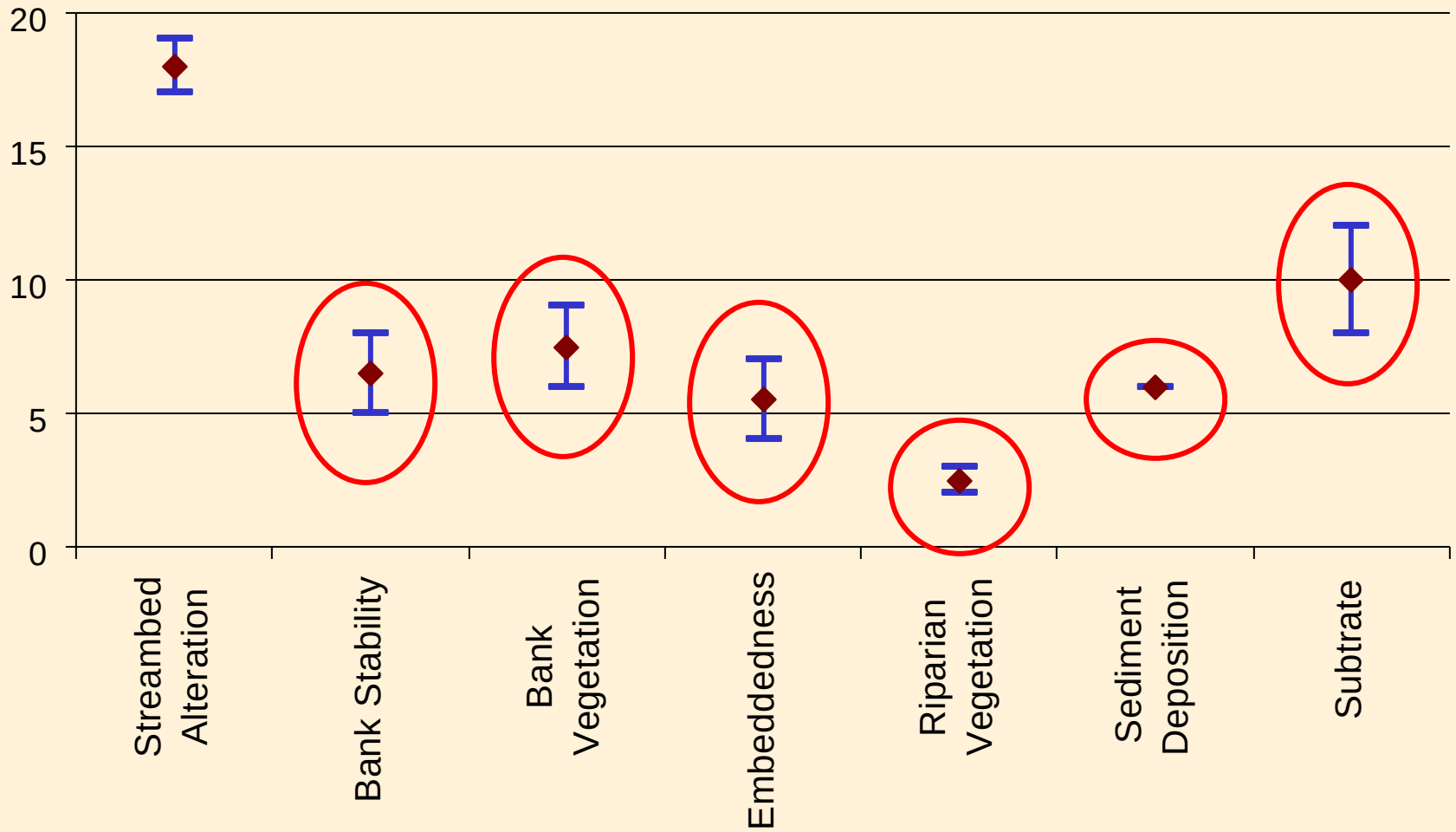
- Water-column toxicity analysis
  - No results to-date
- No monitored pollutants measured at toxic levels
- No suspected sources of toxic pollutants

Christians Creek

- Limited primary energy source – tree leaves ✓
- Sediment ?
- ~~Toxics~~
- ~~Low Dissolved Oxygen (DO)~~
- ~~Nutrients~~
- ~~pH~~
- ~~Metals~~
- ~~Dissolved Solids / Conductivity~~
- ~~Temperature~~
- ~~Organic matter~~

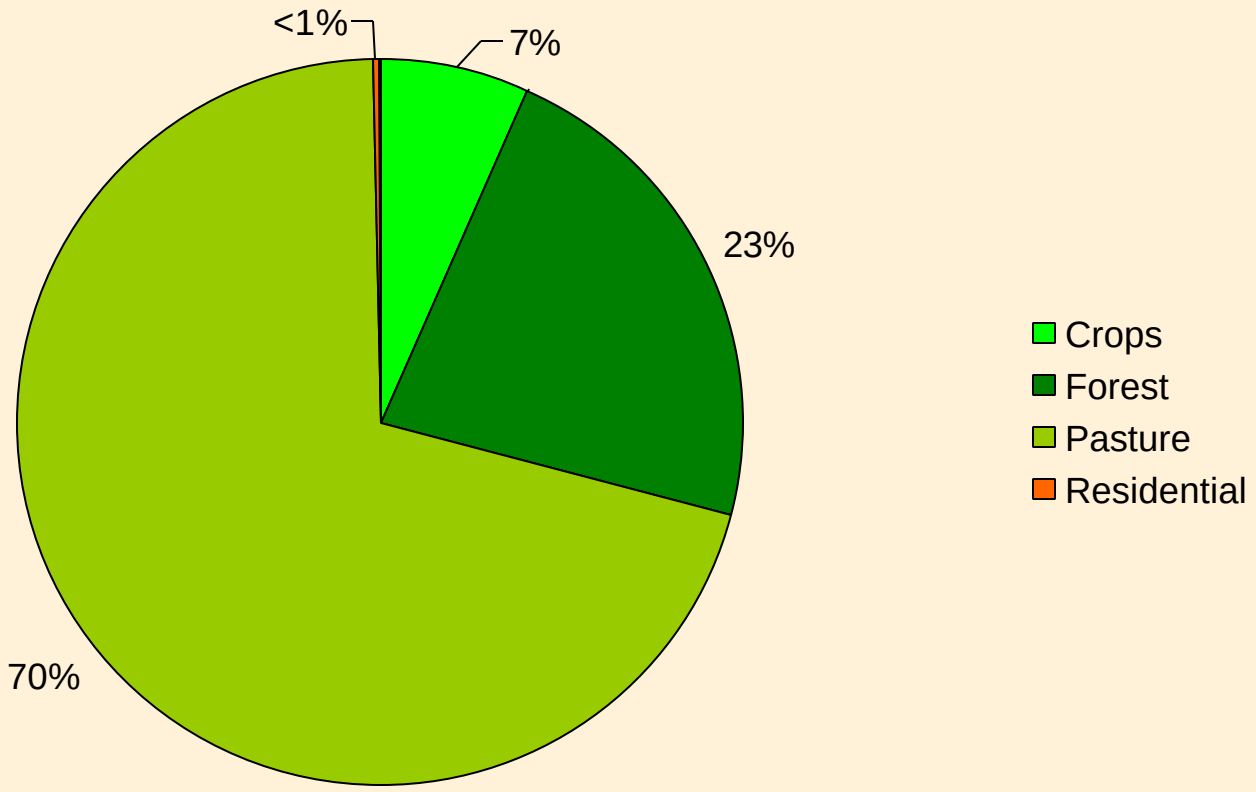
Upper Middle River

Habitat Analysis



Upper Middle River

Land Use in 1st Order Stream Corridor



Upper Middle River
Toxicity Analysis

- Water-column toxicity analysis (*PRELIMINARY*)
  - No impact on survival of fathead minnows
  - Impact on growth of fathead minnows
  - No impact on survival of *C. dubnia*
  - No impact on reproduction of *C. dubnia*
- No monitored pollutants measured at toxic levels
- No Suspected sources of toxic pollutants

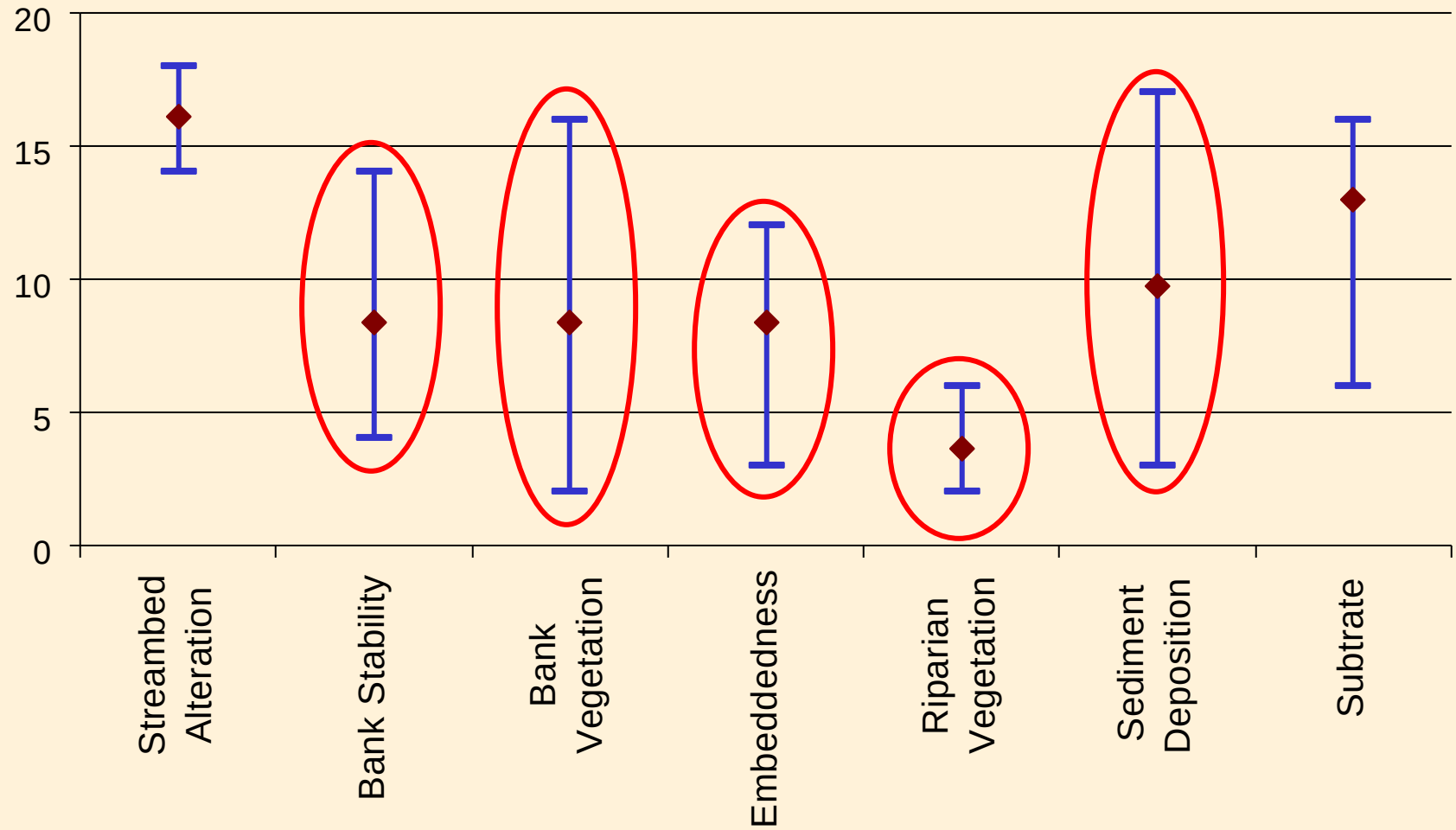
Upper Middle River

Potential Stressors

- Limited primary energy source – tree leaves ✓
- Sediment ✓
- ~~Toxics~~
- ~~Low Dissolved Oxygen (DO)~~
- ~~Nutrients~~
- ~~pH~~
- ~~Metals~~
- ~~Dissolved Solids / Conductivity~~
- ~~Temperature~~
- ~~Organic matter~~

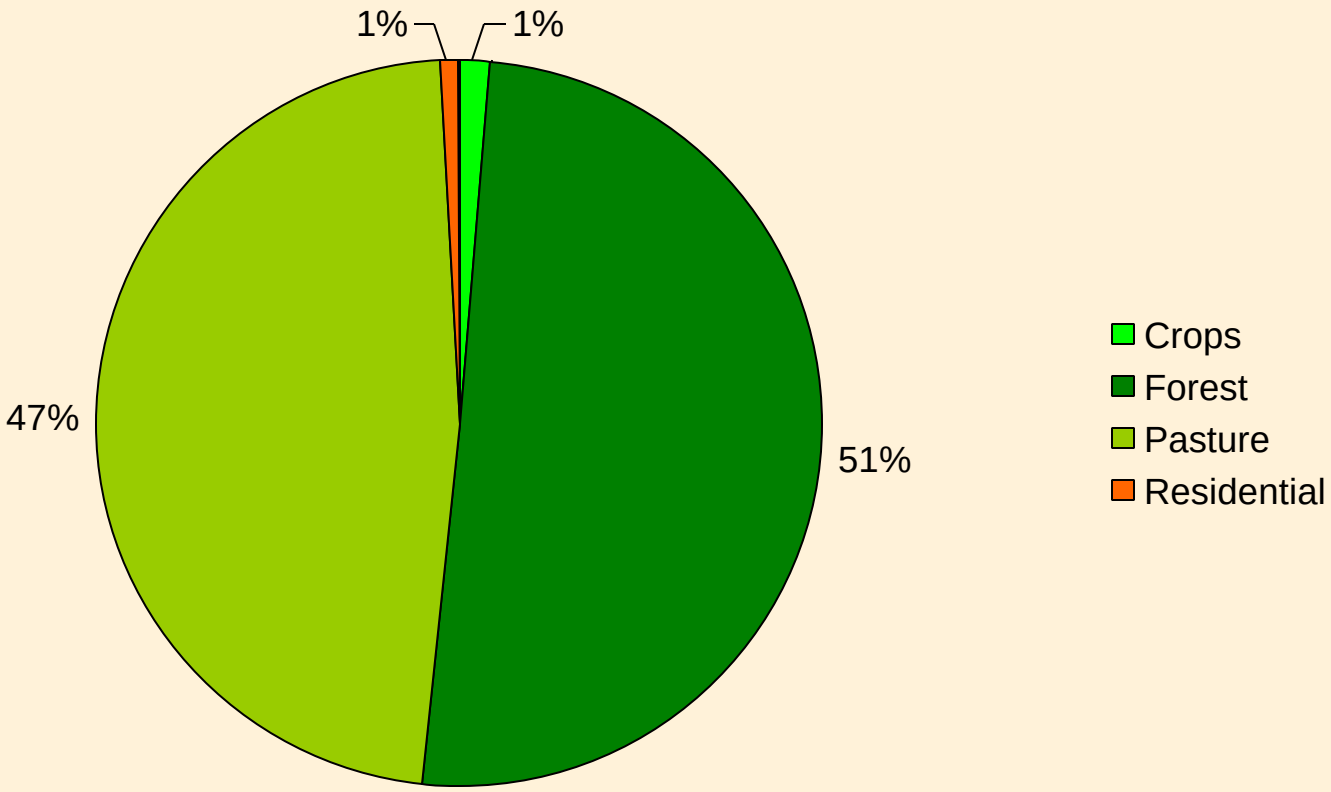
Moffett Creek

Habitat Analysis



Moffett Creek

Land Use in 1st Order Stream Corridor



Moffett Creek
Toxicity Analysis

- Water-column toxicity analysis (*PRELIMINARY*)
  - No impact on survival of fathead minnows
  - Impact on growth of fathead minnows
  - No impact on survival of *C. dubnia*
  - No impact on reproduction of *C. dubnia*
- No monitored pollutants measured at toxic levels
- No Suspected sources of toxic pollutants

Moffett Creek

Potential Stressors

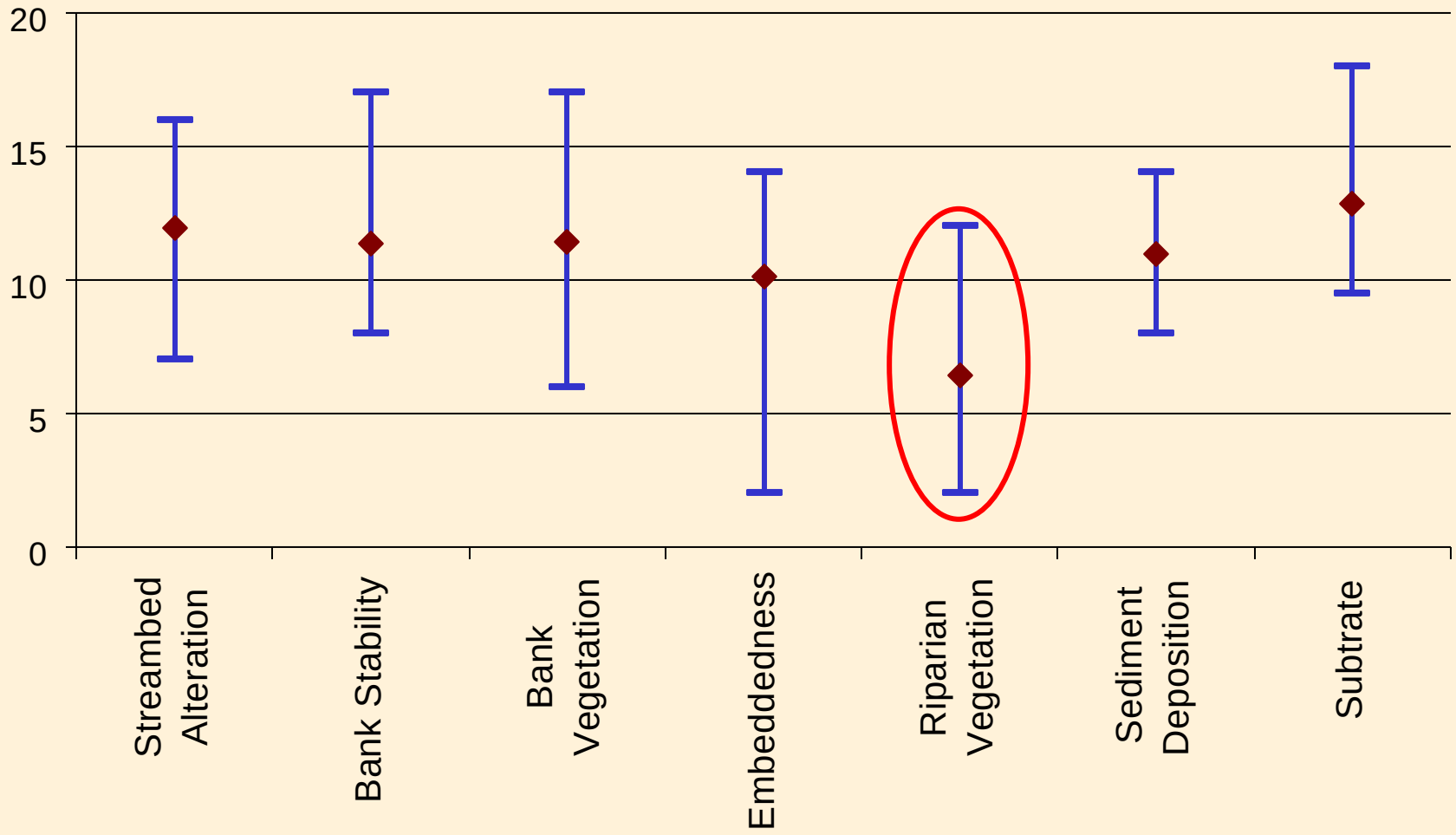
- ~~Limited primary energy source – tree leaves~~
- Sediment ✓
- ~~Toxics~~
- ~~Low Dissolved Oxygen (DO)~~
- ~~Nutrients~~
- ~~pH~~
- ~~Metals~~
- ~~Dissolved Solids / Conductivity~~
- ~~Temperature~~
- ~~Organic matter~~

TMDL Development

- Primary energy source
  - Requirements established based on statistical analysis of impaired and non-impaired watersheds
  - Less than 33% forested riparian corridor on 1st order streams is more likely to be impaired than non-impaired
  - 38% is the lowest value observed in non-impaired streams
- Sediment
  - Model impaired and reference watersheds
  - Set sediment endpoint based on modeled reference watershed

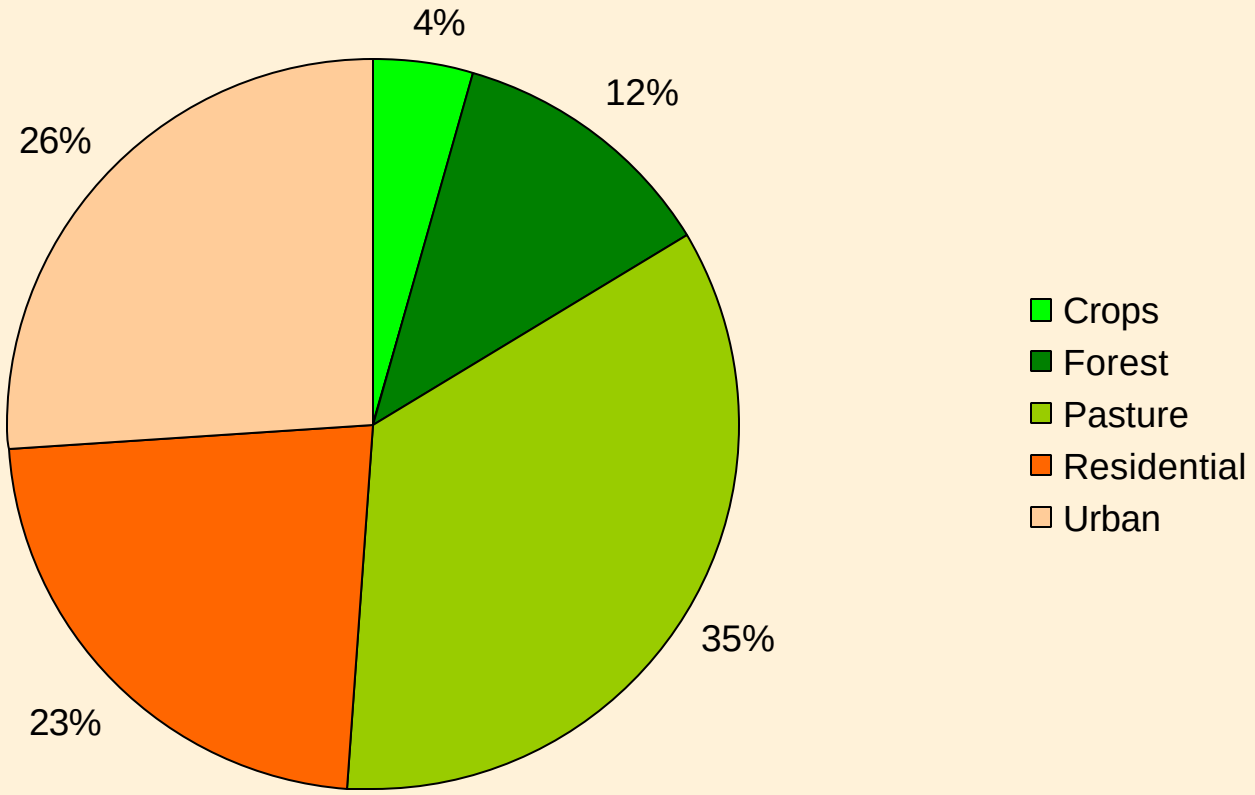
Lewis Creek

Habitat Analysis



Lewis Creek

Land Use in 1st Order Stream Corridor



Lewis Creek
Toxicity Analysis

- Water-column toxicity analysis (*PRELIMINARY*)
  - Impact on survival of fathead minnows
  - Impact on growth of fathead minnows
  - No impact on survival of *C. dubnia*
  - Impact on reproduction of *C. dubnia*
- Toxic pollutants measured in sediment and fish tissues at levels that are likely to impact aquatic life
- Multiple sources of toxic pollutants

Lewis Creek

Potential Stressors

- Limited primary energy source – tree leaves ✓
- ~~Sediment~~
- Toxics ✓
- ~~Low Dissolved Oxygen (DO)~~
- ~~Nutrients~~
- ~~pH~~
- Metals ✓
- ~~Dissolved Solids / Conductivity~~
- ~~Temperature~~
- ~~Organic matter~~

Where from here?

- Final Public Meeting (Date?)
- Public Review (30 days)
- Submit to EPA (30 days)
- State Approval
- Implementation Plan Development
- Implementation

Middle/South River TMDLs
Augusta County

- Department of Conservation and Recreation, Division of Soil & Water Conservation
  - William Keeling, TMDL Project Manager, 804-371-7485
  - Mike Shelor, TMDL Project Manager, 804-786-7717
  - Tamara Keeler, Regional Manager, 540-332-8955
- Department of Environmental Quality
  - Robert Brent, Regional TMDL Coordinator, 540-574-7848
- MapTech, Inc
  - Jim Kern, Contractor, 540-961-7864
  - Email jkern@maptech-inc.com